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INTRODUCING MESH LAYER OVER AIRCRAFT ENGINE DUCT

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ABSTRACT

The aim of this research paper is to protect the aircraft from the birds strike and maintain streamline flow at the entrance of the engine. The theoretical scope of this paper is to save people lives from accident by giving a design which protects the aircraft. To prevent the birds strike we are forming a mesh (or) honey-comb structure before the cowling area of the engine which protects the engine from the birds strike and provide Laminar flow to the power plant. If the mesh structure is nearby the inlet portion it creates turbulence so by using Volute spring we create better lateral stability and also increase the distance between the mesh structure and the cowling part of the engine so that the turbulence is decreased. Volute spring is used to absorb the shock created by the moving mesh structure and it protects the structure from being damaged by the birds strike. Bed shocker is used infront of the cowling area of the design to give the mesh layer ground support. This paper is about preventing birds strike and save the life of the people as well as the expensive aircraft from being crashed just because of small incident. We have to save the life of the people as well as birds which get affected by accident because this is ours and their nature, and they also have the rights to stay and live their lives.

***KEYWORDS**: Mesh (or) Honey-comb structure, momentum, Volute spring, Bed shocker. (4th point; 4-5 word, 6th point; 12-13 word, 10th point; 5-6 word.)*

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Original Article

INTRODUCTION

The title “Introducing mesh layer over the aircraft engine duct” is to protect the peoples' life from that engine failure which was happen by the birds strike and turbulence.

The Mesh (or) Honey-comb like structure is basically the formation of small-small square shape which helps to create the streamline or laminar flow all over the engine inlet and compressor region. Here the mesh layer is created by the 3-D printing resign fibers which is POLYCARBONATE which is known by the name of undisputed king of the material for 3-D printing. Here this polycarbonate material is used because it is the strongest of fibers with 9,800 psi strength to sustain the load or pressure. Here we choose the 3-D material because of various reason like the weight factor which is quite less regarding other materials its ductility and malleability is even very high it can resist up to high pressure and temperature. Here the mesh layer is used in order to increase the laminar flow all over the cowling or inlet region. If we see through the concept-wise this concept comes to mind with the help of seeing the wind-tunnel inlet structure. If we use the same structure in front of the cowling region of the power plant so we got two benefits the first one is that the engine is protected from the birds strike and if we see the second benefits we find that the flow is also converted into laminar or streamline which was earlier in turbulence.

Here when the birds strikes the mesh layer, they have some momentum and with that larger momentum they break the mesh structure and get entered inside the compressor blade and again harm the structure of the blades

and result in engine failure. To avoid this problem, we will analyse the different method that is related to the basic physics concept, which is the concept of momentum, if the force is applied for a short period of time, it gets more impulse and if the time duration is increased then the impact of the force is decreased. Based on this concept, we introduced one another part in it that is Volute sprig.

Volute spring is a different type of spring that is conical in formation and has a greater ability to absorb the shock created by the flows. It plays a key role in stopping the birds from entering inside the compressor blades. If a fast-moving bird is there so it has a large momentum. The momentum of the bird has to be reduced to zero (or) nearer to zeroin order to hold it over the mesh structure, when the bird strike the mesh layer so the spring get compressed and due to which the time increases for the strike and reduce the momentum of the bird to zero due to more time taken to stop the bird, the rate of change of momentum of bird is reduced and hence the smaller force is exerted on the mesh structure so the structure doesn't get damaged. If we don't use the volute spring the fast-moving bird hits the structure, then the large momentum of the bird will be reduced to zero in a very short interval of time due to which the rate of change of momentum of bird will be very large which will exert a large impact force on mesh structure causing the damage to the structure.

When the bird gets stopped by the mesh layer, the bird's body exert huge impact force over the layer because of its own velocity and the suction created by the aircraft engine and another one the velocity of the aircraft so all together totally three forces are working against the mesh layer. To prevent the mesh layer from breaking we use a volute spring which maintains the lateral stability of the mesh layer and absorbs the shock produced by the birds strike. We use here the simple concept of physics which is known as momentum. To reduce the impact of the force, we increase the time of contact with the mesh layer, so the mesh layer experiences less impact force and we can protect the mesh layer from damage.

We use a bed shocker to provide support to the mesh layer and the volute spring to prevent the mesh layer from going down by the earth’s gravitation or at the time of landing there is bounce back of the aircraft landing gear so to prevent it from going down we give support of bed shocker which also help in maintaining shock absorbance and maintain stability.

OBJECTIVES OF THE STUDY

This mesh layer is formed to save the lives of the people and the companies money.

In the past two-decades around 106 civilians death was confirmed worldwide and there is huge loss faced by the aeroplane companies which was around $1.2 billion a year in damage. And around 14,661 collisions of wildlife in 2018 was reported, that's all together coming up to 40 collisions a day.

This mesh layer can't decrease the rate of strikes but it can save the lives of people and money of the companies, as we know that for every company safety is the priority.

OBJECTIVES

- This layer becomes **a life saver for humans** during flight. It also **secures the lives of the birds** by its light method and allows them to deviate from the aircraft path.
- This layer **protects the engine from birds strike** due to which every year Civilian flights based in the USA reported 14,661 collisions with wildlife in 2018, a USA TODAY analysis of Federal Aviation Administration data shows. That's more than 40 a day, tying last two year's record.

- It **continuously maintains a streamlined flow over the compressor blades** due to which **less turbulence is feel by the blades**.
- This **layer becomes as a money saver** also for the aircraft industry and commercial flight company this cause about **$1.2 billion a year in damage**.
- **Less accident** will happen after this layer is introduced to the aeronautical field.

MATERIALS

Polycarbonates is a thermoplastic that is most prominently known for its incredible strength and impact resistance. It is flame retardant and insulates electricity.

LEXAN

This is one of the best polycarbonate material. It is extremely durable and highly effective for a wide range of professional-level application.

Properties of LEXAN

Lower working temperature = -40 degree Celsius.

Upper working temperature = 115-130 degree Celsius.

Heat deflection temperature = 0.45 Mpa :140 degree Celsius.

Thermal conductivity (k) at 23 degree Celsius = 0.19 -0.22 W/(m·K)

Thermal diffusivity (a) at 25 degree Celsius = 0.144.

Volute spring made up ofsteel sheet and other steel grades as per requirement.

Bed shocker is made up of stainless steel and it can be available in different specification to suit the needs of the client.

Stainless steel is a family of iron-based alloys that contain a minimum of approximately 11% chromium,a composition that prevents the iron from rusting) as well as providing heat resistant properties.

METHODOLOGY

Birds are the frequent flyers in the atmosphere so whenever an aircraft came in front of birds, they don't respond quickly because of the speed of the aircraft and the suction created by its engine. Even though the birds don't want to confront an aircraft, because of its speed and suction it happens.

After this incident, a research is done by us and by that result we came to know that average diameter of the jet engine is (9feet-11feet) which is about (274.32cm-335.28cm) so putting those research in mind, another survey is performed by us under which we came to know that the average size of the birds who generally get stroked by the aircraft are in the size of :-

- 3-5 inch (7.62cm-12.7cm)for very small birds.

- 5-9 inch (12.7cm-22.86cm)for small birds.
- 9-16 inch (22.86cm-40.64cm)for medium birds.
- 16-32 inch (40.64cm-81.28cm)for large birds.

So by getting this result we get to know that the average aircraft crash happens at the time of take-off, initial climb, approach or landing and in rare condition during cruise time.

Sowe concluded that at this height, very small birds, small birds, medium birds are flying frequently because of lower levels. So after all these all survey and research, we concluded for the best design which is safe and secure for both birds and the aircraft.

Note:- According to Indian Air Force (IAF), the Black Kite is the species most involved in bird strikes in India. Between 1966 and 2018, there would have been 1041 "incidents" with birds involving 95 species. In most cases, Black Kites (166) were involved followed by the swifts(99), lapwing (98), vultures (85), bats (75) and pigeons (70).

BIRD STRIKE CASES AND YEARS

Figure 1

The above graph states that with the increase in time birds strike rate is also increasing so based on this study we have to be careful about the future because in upcoming time definitely we have more numbers of aircraft and due to that we have more numbers of birds strike rate.So after thinking on each and every aspect we came to the conclusion that a Mesh layer is introduced to protect birds as well as aircraft. So for the best result we, At first made a 2D sketch which is quite similar to the 3D view of the design from the front view after this 2D sketch completion according to the average data we created the3D design of the mesh layer by using the commercial design software where all the dimension, distance,spacing between the substances everything is based on the study of the material and their characteristics.

Here is the 3D front view of the mesh layer which is created by commercial design software:-

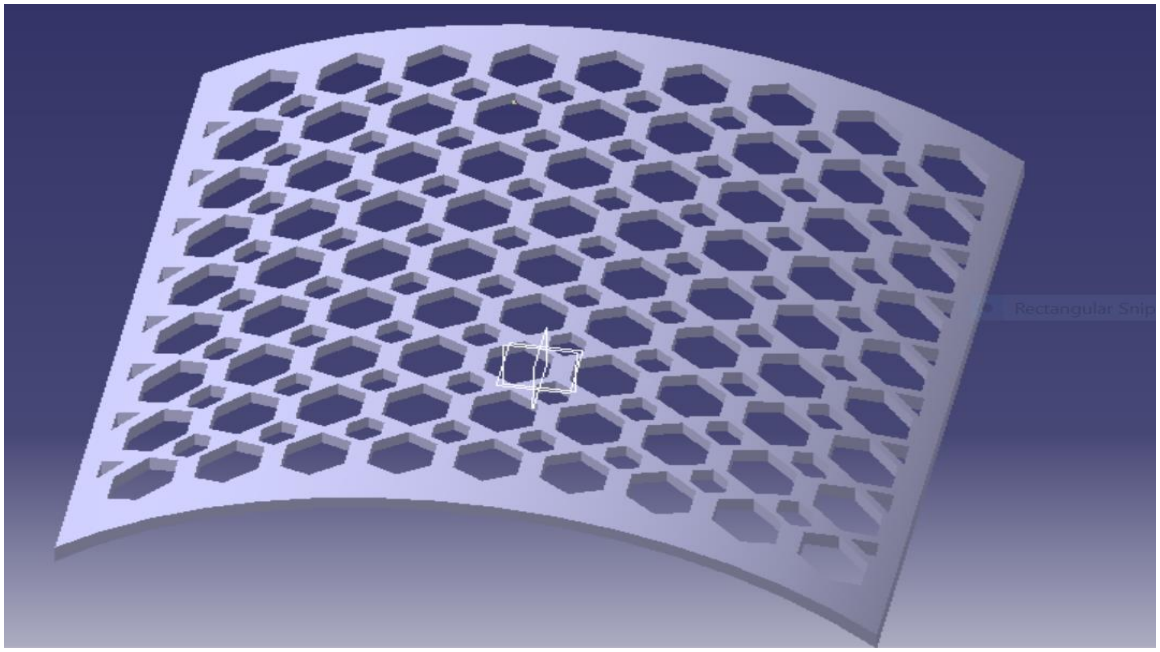
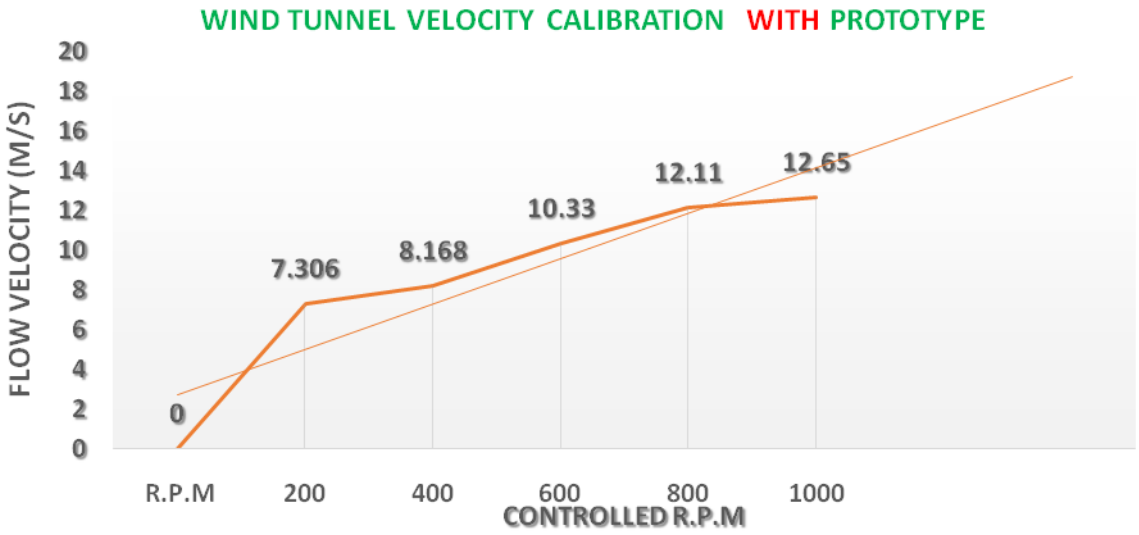


Figure 2

Graphical Abstract



By observing the graph, we can understand that with the prototype the flow velocity is stable at the RPM of 200. We find that flow velocity is between the range of 7 to 8. Only when we go for 400 and 1000 RPM, we obtain that a smooth increase in the flow velocity and maintain the laminarflow for the aircraft engine. This makes all the turbulence airflow inside the engine into a laminar and streamlines flow, also increasing the efficiency of the aircraft engine.

RESULTS AND DISCUSSIONS

A new design is proposed for enhancing protection against the bird strike situation for an aircraft. This design doesn't require any human interference to operate. It will work by mechanical procedure. Its Twin Hexagonal design surface is

basically designed to engage the bird at the mesh layer surface onwards & doesn't let them enter inside the engine.

And if any bigger or smaller bird strikes with too much force, the volute spring installed there will bounce back that bird thus ensuring that it won't hit the engine afterwards. Thus we can achieve flight without fear of bird strike or emergency landing for bird strikes after installing this design in subsonic passenger aircraft.

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